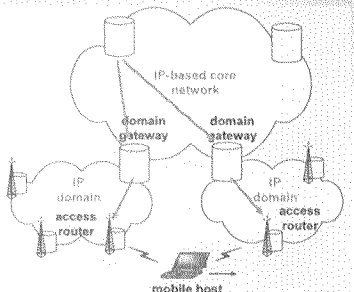
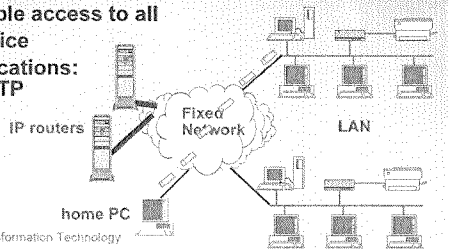
Mobile & wireless IP-based networks

- Connectivity of mobile terminals to the Internet
  - Macromobility: move from one IP-domain to another (MIP)



IP-based networks

- The Internet today
  - Robust worldwide network for data exchange
    - Global interconnection of > 140M hosts
    - Interoperability between different computer networks (LANs) and different network infrastructures
  - Connectionless packet based technology (IP-protocol)
  - Fair and equitable access to all
  - Best effort service
  - Dominant applications: e-mail, FTP, HTTP



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NETW 1103

Wireless networks team: roadworkers on the information sideways

Ingrid Moerman, Bart Dhoedt, Piet Demeester

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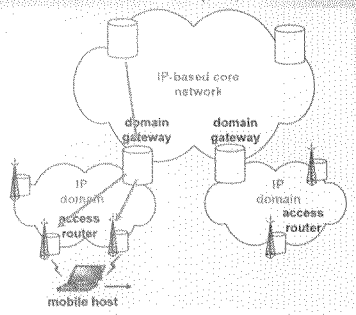
http://www.intec.rug.ac.be

imec

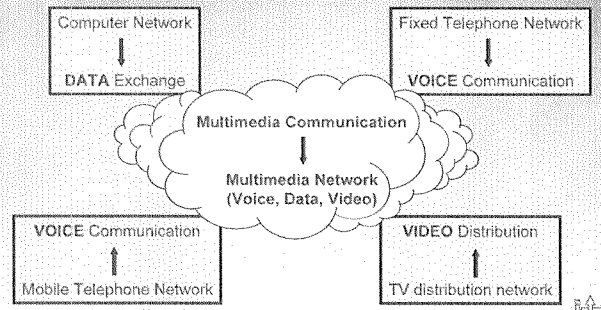
Mobile & wireless IP-based networks

- Connectivity of mobile terminals to the Internet
  - Macromobility: move from one IP-domain to another (MIP)
  - Micromobility: move from one access router to another in the same IP-domain (CIP, HAWAII, HMIP)



IP-based networks

- The Internet tomorrow
  - Service integration into multimedia network



OUTLINE ARRM 2002

- The importance of the Internet
  - IP-based networks
  - QoS enabled IP networks
  - Mobile & wireless IP-based networks
- Research at INTEC/IBCN: IP-based networks
- QoS in mobile & wireless IP-based networks
  - Routing in mobile ad-hoc networks (MANETs)
  - Broadband wireless communication in vehicles
  - Wired access network part of mobile IP-based networks

Mobile & wireless IP-based networks

- Challenges
  - How to handle packet loss over a wireless link (BER ≠ 0)
    - IP-networks are designed for wired links (BER = 0)
    - Need for modifying existing protocols or using protocol boosters
  - Seamless handover
    - No interruption of connection
    - No packet loss
    - No delay
  - QoS support
    - Support of different applications with different requirements
  - Fast moving terminals
    - Development of intelligent routing strategies to allow fast handover

QoS enabled IP networks

- The Internet tomorrow
  - Various applications over one integrated network
  - Different requirements for different applications
  - The need for QoS classes

QoS class	Example	Bit rate	Low BER	Guaranteed bitrate	Transfer delay	Variation of delay
Coversational	VoIP	14 kb/s	No	Yes	Stringent	Stringent
Streaming	Video	5 Mb/s	No	Yes	Fixed	Fixed
Interactive	WWW	1 Mb/s	Yes	No	No	No
Background	E-mail	0.5 Mb/s	Yes	No	No	No

- Different mechanisms for QoS:
  - IntServ, Diffserv
  - RSVP
  - MPLS

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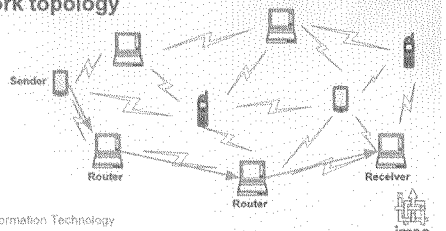
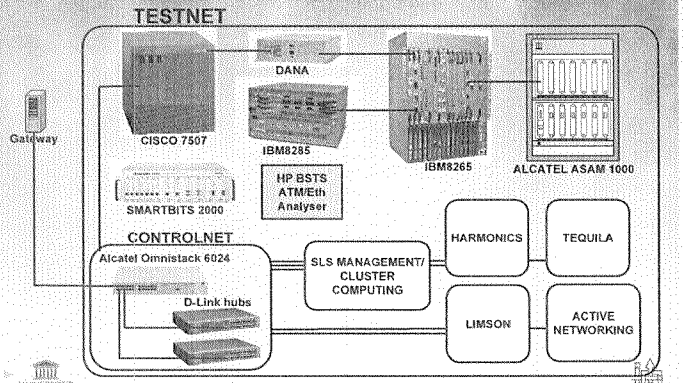
Routing in MANETs

- What is a MANET?
  - Autonomous network
  - No fixed infrastructure
  - Mobile heterogeneous nodes:
    - Terminal and router functionality
    - Limited resources
  - Dynamic network topology



Testlab ATLANTIS



OUTLINE ARRM 2002

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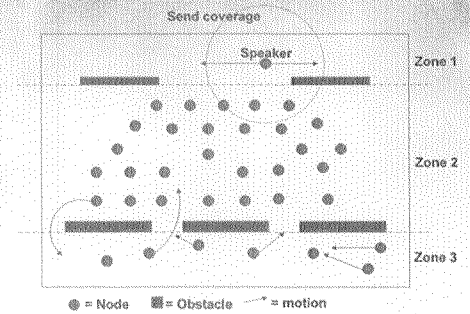
Routing in MANETs

- Possible scenario: conference room



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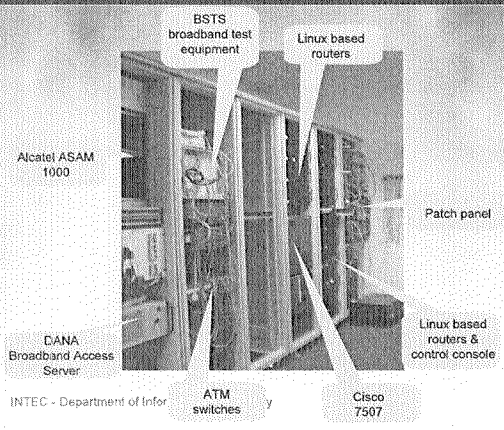
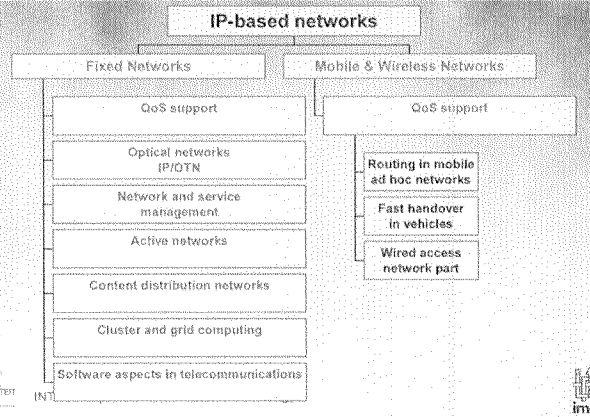
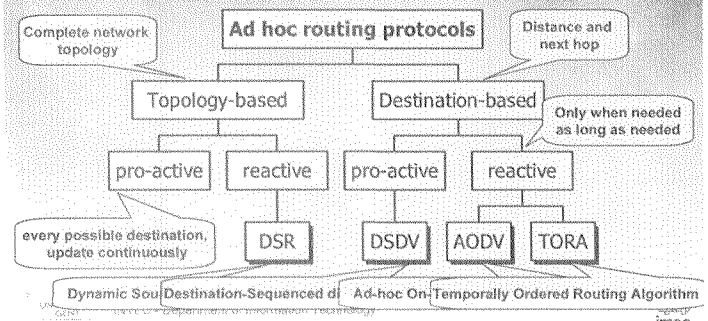


Research at INTEC/IBCN



Routing in MANETs

- Evaluation of protocols:
  - Simulation of mobility and scalability



OUTLINE ARRM 2002

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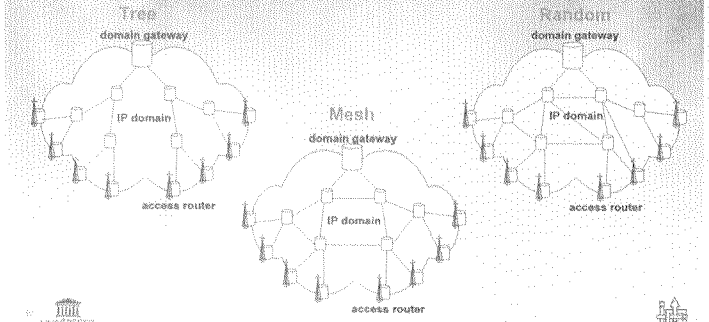
Research at INTEC/IBCN

- Theoretical work:
  - Development and analysis of new protocols and algorithms
  - Design and evaluation of network and node architectures
  - Development of software architectures and performance evaluation
  - Simulations
- Practical work:
  - ATLANTIS test laboratory
  - Validation of theoretical concepts and results

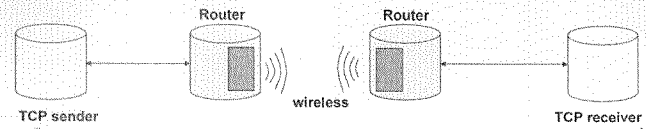
Wired access network part

- Influence of topology on performance of different micromobility protocols (CIP, HAWAII, HMIP)



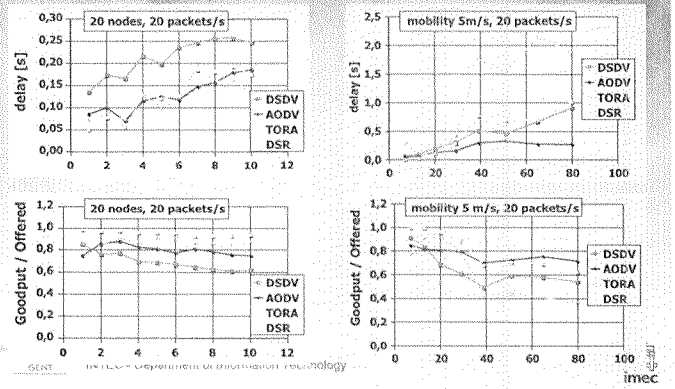
TCP protocolbooster

- Target
  - To improve TCP-performance over wireless link
  - To increase throughput over wireless link
- Properties of protocol booster
  - Add, remove, delay protocol messages
  - Booster messages are transparent for TCP protocol
  - Detection of transmission errors
  - Detection of congestion



Routing in MANETs

- Mobility
- Scalability



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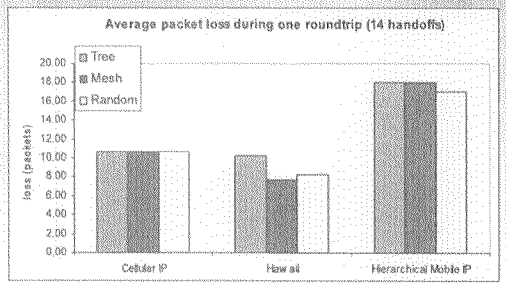
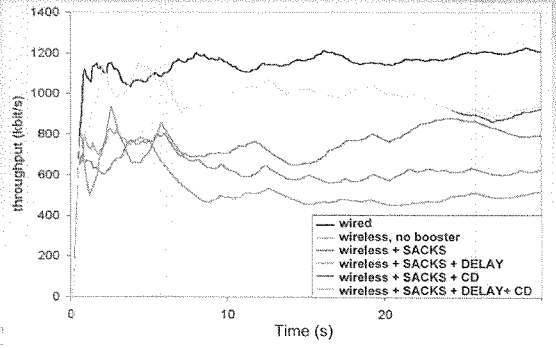
- Influence of topology on performance of different micromobility protocols (CIP, HAWAII, HMIP)



TCP protocol booster: Simulations

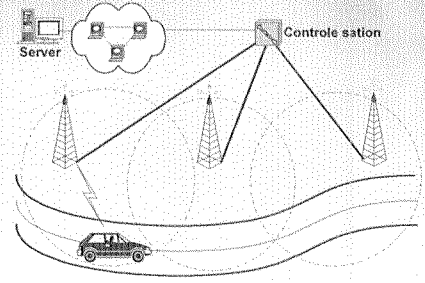
- Throughput vs time

Wireless link: bandwidth 10Mb/s, delay 10ms
0.5% congestion after wireless link



Fast handover in vehicles

- Broadband wireless communication in vehicles
  - Encouraging of carpooling and public transport
  - Need for Internet and multimedia applications in car or train



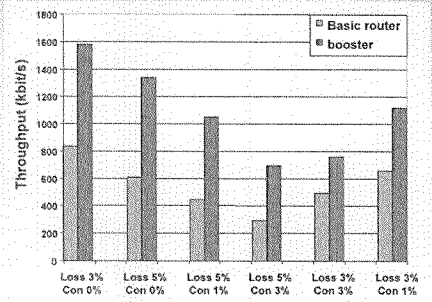
End

?

TCP protocol booster: Implementation

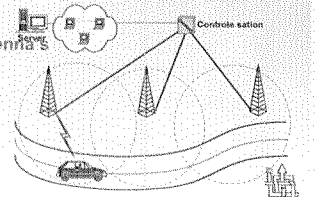
- Mean throughput

Wireless link losses: 3% en 5%
Congestion before wireless link: 0%; 1% en 3%



Fast handover in vehicles

- Broadband wireless communication in vehicles
  - Issues
    - No existing handover protocols and network infrastructure which allow high bandwidth AND high mobility AND seamless handover
    - Packet loss over wireless link
  - Solution
    - Intelligent routing protocol taking into account position and trajectory of vehicle
    - Cellular infrastructure with directional or smart antennas
    - Protocol boosters



Mobile Multimedia Communication Systems and Networks

P. Demeester & I. Moerman (Ghent University - INTEC), M. Moeneclaey (Ghent University - TELIN), A. Van Calster (Ghent University - ELIS), L. Vandendorpe (Université Catholique de Louvain), G. Leduc (Université de Liège), J. Cornelis (Vrije Universiteit Brussel), M. Moonen (Katholieke Universiteit Leuven), M.-A. Remiche (Université Libre de Bruxelles), C. Blondia (University of Antwerp)

Abstract

The MOTION project 'Mobile Multimedia Communication Systems and Networks' is a research program supported by the Belgian Science Policy Office through contract No. PS/11. The IAP-MOTION project focuses on next generation multimedia services and future Quality of Service (QoS) enabled mobile/wireless IP-based networks with reliable and bandwidth efficient wireless links. Novel concepts and generic technologies are developed for the support of future mobile multimedia networks, covering aspects from the application level down to the physical channel. The main topics related to applications are: software architecture for the negotiation between content providers and terminals using dynamic metadata, object-based, highly scalable wavelet video coding schemes and new display driver concepts. The main multimedia network related topics are: new data link, IP and transport protocols supporting mobility and providing QoS for fast moving portable devices in homogeneous and heterogeneous environments. QoS-enabled mobile ad hoc networks, traffic and performance models, queuing models. At the level of the physical channel, the following topics are studied: modulation and receiver algorithms for advanced modulation and transmission techniques such as MIMO (multiple input - multiple output), and innovative antenna designs such as smart antennas.

In this project 9 research partners from 7 Belgian universities (Ghent University, Université Catholique de Louvain, Université de Liège, Vrije Universiteit Brussel, Katholieke Universiteit Leuven, Université Libre de Bruxelles, University of Antwerp) have bundled their expertise at the different levels required for the development of future mobile multimedia communication systems and networks. The strength of the network resides in the close interaction of the partners within and between the different fields of expertise. Besides the research activities, the network also contributes to the training of PhD students, to courses in masters programs, to the organization of workshops, etc.

More information on the IAP-MOTION project can be found on http://www.ipcr.ac/Sum.htc.